VDH VIRGINIA DEPARTMENT OF HEALTH
Protecting You and Your Environment

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ACETIC ACID

GENERAL BACKGROUND

Acetic acid is also known as ethanoic acid, ethylic acid, vinegar acid, and methane carboxylic acid; it has the chemical formula of CH_3COOH (molecular weight of 60.05). Glacial acetic acid is the pure compound (99.8%), as distinguished from the usual water solutions known as acetic acid. It is a colorless liquid with a pungent, vinegar-like odor, and has an upper taste threshold of 1,000 parts per million (ppm), a lower taste threshold of 300 ppm, and an odor threshold of 24 ppm. The boiling point of acetic acid is 118°C and the melting point of its rhombic crystals is 16.6°C. Glacial acetic acid is highly corrosive to metals. Acetic acid is soluble in alcohol, miscible with water, glycerol, ether, acetone, benzene, carbon tetrachloride, and practically insoluble in carbon disulfide.

PRODUCTION AND USES

Commercial production of acetic acid is often accomplished by a chemical reaction of methanol and carbon monoxide (with catalyst). Other production methods include liquid- and vapor-phase oxidation of petroleum gases (with catalyst), oxidation of acetaldehyde, and fermentative oxidation of ethanol. Acetic acid is the 33rd highest-volume chemical produced in the United States.

Acetic acid is used in the manufacture of acetic anhydride, cellulose acetate, vinyl acetate monomer, acetic esters, chloracetic acid, plastics, dyes, insecticides, photographic chemicals, and rubber. Other commercial uses include the manufacture of vitamins, antibiotics, hormones, and organic chemicals, and as a food additive (acidulant). It is also used in various textile printing processes. Vinegar and "dilute acetic acid" are about 4% to 6% acetic acid. Essence of vinegar is 14% acetic acid.

NATURAL SOURCES

Acetates (salts of acetic acid) are common constituents of animal and plant tissues and are formed during the metabolism of food substances. Typical concentrations of acetic acid occurring naturally in foods are 700 to 1,200 milligrams/kilogram (mg/kg) in wines, up to 860 mg/kg in aged cheeses, and 2.8 mg/kg in fresh orange juice. Estimated possible average daily intakes of acetic acid and sodium acetate (based on food intake concentrations) for persons more than 2 years old are estimated at 2.1 grams (g)/day and 0.23 g/day, respectively.

Acetic acid is absorbed from the gastrointestinal tract and through the lungs. It is readily metabolized by most tissues and may give rise to the production of ketones as intermediates. In vitro experiments have demonstrated that acetate is incorporated into phospholipids, neutral lipids, steroids, sterols, and saturated and unsaturated fatty acids in a variety of human and animal tissue preparations.

HEALTH EFFECTS

Humans

Acetic acid is a strong eye, skin, and mucous membrane irritant. Prolonged skin contact with glacial acetic acid may result in tissue destruction. Inhalation exposure (8 hours) to acetic acid vapors at 10 ppm could produce some irritation of eyes, nose, and throat; at 100 ppm marked lung irritation and possible damage to lungs, eyes, and skin might result. Immediately dangerous to life or health (IDLH) vapor concentrations of 1,000 ppm cause marked irritation of eyes, nose and upper respiratory tract and cannot be tolerated. These predictions were based on animal experiments and industrial exposure. Skin sensitization to acetic acid is rare, but has occurred.

It has been reported that, in 12 workers exposed for two or more years to an estimated mean acetic acid airborne concentration of 51 ppm, there were symptoms of conjunctival irritation, upper respiratory tract irritation, and hyperkeratotic dermatitis. Exposure to 50 ppm or more is intolerable to most persons and results in intensive lacrimation and irritation of the eyes, nose, and throat, with pharyngeal edema and chronic bronchitis. Unacclimatized humans experience extreme eye and nasal irritation at concentrations in excess of 25 ppm, and conjunctivitis from concentrations below 10 ppm has been reported. In a study of 5 workers exposed for 7 to 12 years to concentrations of 80 to 200 ppm at peaks, the principal findings were blackening and hyperkeratosis of the skin of the hands, conjunctivitis (but no corneal damage), bronchitis and pharyngitis, and erosion of the exposed teeth (incisors and canines).

Experimental Animals

Rats receiving acetic acid in their drinking water (up to 0.5 percent) for 2 to 4 months (daily doses up to 390 mg/kg) were found to lose body weight (apparently due to anorexia) at the highest dose, but no such effects were observed up to concentrations equivalent to 195 mg/kg daily. There were no fatalities in any of these dose groups. In rats fed acetic acid (4.5 g/kg/day) in the diet for 30 days, gastric lesions occurred in some animals, whereas others revealed slight forestomach wall thickening or inflammatory changes. Rats exposed to 2,000 ppm acetic acid vapors for 4 hours died, but 1,000 ppm for 4 hours was not lethal.

On guinea pig skin, acetic acid in concentrations in excess of 80% produced severe burns; concentrations of 50% to 80% produced moderate to severe burns; solutions below 50% caused relatively mild injury; no injury was produced by 5% to 10% solutions.

Carcinogenicity

Acetic acid has not been shown to be carcinogenic in animal studies. Male rats given sodium acetate (sodium salts of acetic acid) orally (350 mg/kg, three times weekly for 63 days followed by 140 mg/kg, three times weekly for 72 days) showed no histologic evidence of tumors.

Mutagenicity

Acetic acid has not been shown to be mutagenic in animal studies. Acetic acid (sodium salt) elicited no mutagenic response in Salmonella typhimurium or Saccharomyces cerevisiae, with or without liver preparations from mouse, rat, or monkey.

Teratogenicity

Acetic acid has not been shown to be teratogenic in animal studies. Pregnant rabbits administered apple cider vinegar (1.6 g/kg/day) showed no increased fetal abnormalities or mortality compared to sham-treated controls. No teratogenic effects on developing chicken embryos were observed after injection of sodium acetate (100 mg/kg) into the yolk or air cell of eggs after 96 hours of incubation.

STANDARDS AND GUIDELINES

The Occupational Safety and Health Administration (OSHA) standard for airborne acetic acid as an eight-hour, time-weighted average (TWA) is 10 ppm. The American Conference of Governmental Industrial Hygienists (ACGIH) has adopted a threshold limit value (TLV) of 10 ppm. The United Sates Food and Drug Administration (FDA) has affirmed that acetic acid is generally recognized as safe as a multipurpose food additive, as a substance migrating to food from cotton and cotton fabrics used in dry-food packaging, as a substance migrating to food from paper and paperboard products, and as a general purpose food additive for animal feed.

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